IS/ENG 06 1006 Carry over

Mechanical Engineering

Question 1

V = 415V 3 ∅ 4 wire f = 50Hz . P = 74.6

pf = 0.7, & 0ff - 85%

1) Unity = 1

$$C = \frac{KVAR}{2\pi f V^2}$$

$$\Rightarrow KVAR = P \times (\tan \text{actual p.f} - \tan \text{target p.f.})$$

actual pf $\Rightarrow \cos\theta = 0.7$

$\theta = \cos^{-1} 0.7 = 45.57$

$\tan(45.57) = 1.0201$

target p.f $\Rightarrow \cos\theta = 1$

$\theta = \cos^{-1} 1 = 0$

$\tan 0 = 0$

$KVAR = 74.6 \times (1.0201 - 0) = 76.10$

$$C = \frac{76.10}{2 \times \pi \times 50 \times 415^2} = 0.00000014$$

$= 1.4 \times 10^{-6} C.$

b) 0.9 lagging

actual p.f = 1.0201

target p.f = $\cos\theta = 0.9$

$\theta = \cos^{-1}(-0.9) = 154.4$

$\tan\theta = -0.48$

15/ENG06/007 QUESTION 1

Mechanical Engineering

Carry over

$KVAR = 74.6 \times (1.0201 - (-0.48)) = 111.90 \simeq 11$

$$C = \frac{KVAR}{2\pi f V}$$

$$= \frac{112}{2 \times \pi \times 50 \times 415^2} = 0.0086 = 2.07 \times 10^{-6}$$

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Question 2

$V_1 = 415V$

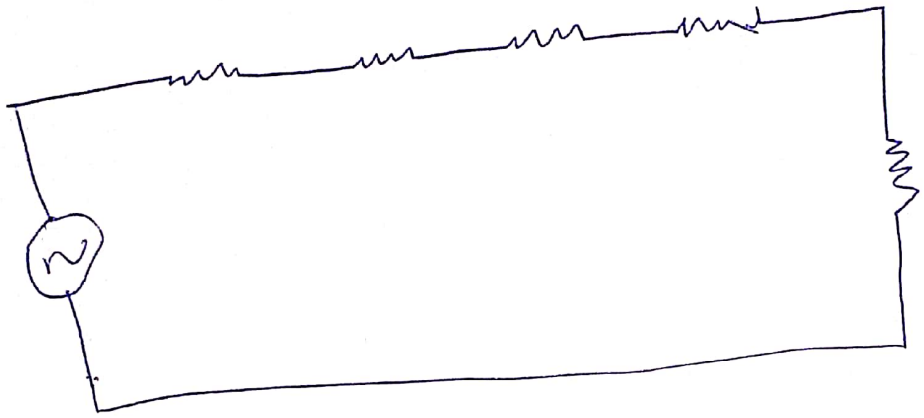
No of poles = 6

$f = 50Hz$

$k = 5/6 = 0.83$

$R_1 = Z_1 = 0.25 + j0.75$ — Stator

$Z_2 = 1.175 + j0.52$ — rotor



Supply voltage per phase $V = \frac{415}{\sqrt{3}} = 239.60V$

Reffering to rotor

$R_{02} = (R_2 + k^2 R_1)$

$= (1.173 + (5/6)^2 \times 0.25)$

$R_{02} = 1.347\Omega$

$X_{02} = (X_2 + k^2 X_1)$

$= j(0.52 + (5/6)^2 \times 0.75$

$= 1.041$

$Z_{02} = R_{02} + X_{02}$

$= 1.347 + j1.041$

$Z_{02} = \frac{1.347 + j1.041}{\sqrt{1.347^2 + 1.041^2}}$

$= 1.7\Omega$

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To Mechanical Engineers

Question 2

$$I_0 = \frac{E_0}{Z_{02}}$$

Recall that $E_2 = kV_1$

$= 2396 \times 0.83$

$= 199.67\ V$

$$\therefore I_2 = \frac{199.67}{1.7} = 117.45\ A$$

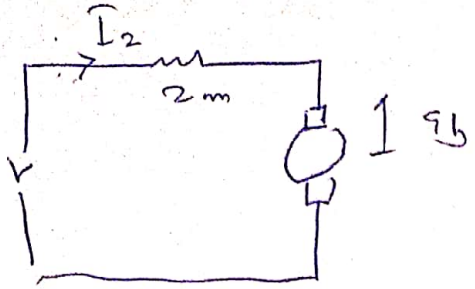
15/ENG06/006 Carry over

Mechanical Engineering

1/4 hp

Question 3

$I = 0.7A$



$V - Eb = I_L \times R$

$Eb = 220V - [20 \times 0.7$

$Eb = 206V$

$Ndc = 2000 rpm.$ ⟶

For A.c supply

$V = 220V$

$I = 0.7A$

Resistance Drop $= I \times R = 0.7 \times 20 = 14V$

Reactance Voltage $= I_L \times XL = 0.7 \times 2 \times fL$

$XL = \omega L = 2\pi fL$

$= 0.7 \times 2\pi \times 50 \times 0.25$

$= 54.98V$

$Eb\,ac = \sqrt{V^2 - [IX]^2} - IR$

$= \sqrt{(220)^2 - [54.98]^2} - 14$

$Ebac = 199.0$

$Ndc = 2000 \times \frac{199.0}{206} = 1950.2 rpm$

ii) Power factor $= \cos\theta = \frac{Ebac + IR}{V} = \frac{199.0 + 14}{220} = 9.15$

~~$\theta = \cos^{-1} 9.15$~~

$\cos\theta = 9.15$

iii) Torque $= \frac{Ebac \times Ia}{2\pi \times \frac{Nac}{60}} = \frac{199.0 \times 0.7 \times 60}{2\pi \times 199.0} = 6.685$ Nm